# B.K. BIRLA CENTRE FOR EDUCATION
### SARALA BIRLA GROUP OF SCHOOLS
### A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

## ANNUAL EXAMINATION (2025-26)
## MATHEMATICS (041): SET 1

**Class: XI**  **Time: 3hrs**
**Date: 23-02-26**  **Max Marks: 80**
**Admission no:**  **Roll no:**

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**General instructions:**
1. The Question paper contains- five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 very short (VSA)- type questions of 2 marks each.
4. Section C has 6 short (SA)- type questions of 3 marks each.
5. Section D has 4 long (LA)- type questions of 5 marks each.
6. Section E has 3 source based/case-based questions of 4 marks each

## SECTION A (20 X 1= 20)

**Q1.** If $(x, 3y, 4) = (4, -3, 2z)$, then the value of $x + 2y + 2z$ is
(a) 6  (b) 1  (c) $-1$  (d) None of these

**Q2.** The value of $i^{49} + i^{50} + i^{51} + i^{52}$, where $i = \sqrt{-1}$, is
(a) 1  (b) 0  (c) $i$  (d) None of these

**Q3.** The intercept form of the equation of the line $7x + 4y - 28 = 0$ is
(a) $\frac{x}{4} + \frac{y}{7} = 1$  (b) $\frac{x}{-4} + \frac{y}{-7} = 1$  (c) $\frac{x}{4} + \frac{y}{-7} = 1$  (d) None of these

**Q4.** If $\lim\limits_{x \to 1} \frac{x^4 - 1}{x - 1} = \lim\limits_{x \to k} \frac{x^3 - k^3}{x^2 - k^2}$, then $k$ is
(a) $\frac{2}{3}$  (b) $\frac{8}{3}$  (c) $\frac{4}{3}$  (d) None of these

**Q5.** Five marbles are drawn from a bag containing 7 blue and 4 black marbles. The probability that all the marbles drawn are blue is
(a) $\frac{5}{11}$  (b) $\frac{2}{11}$  (c) $\frac{1}{22}$  (d) None of these

**Q6.** An arc of a circle of length $\frac{330}{7}$cm subtends an angle $\frac{3\pi}{4}$ at the centre. The radius of the circle is
(a) 10 cm  (b) 20 cm  (c) $11\frac{1}{4}$cm  (d) None of these

**Q7.** Solve: $4x + 7 < 6x + 3$ for real values of $x$.
(a) $x \in (2, \infty)$  (b) $x \in (-\infty, 2)$  (c) $x \in (-2, \infty)$  (d) $x \in (-\infty, -2)$

**Q8.** If $\frac{1}{9!} + \frac{1}{10!} = \frac{x}{11!}$, find $x$.

(a) 100          (b) 90          (c) 110          (d) 121

**Q9.** The coordinates of the centre of the circle $x^2 + y^2 + 4x - 6y + 8 = 0$ are

(a) $(-2, -3)$      (b) $(2, 3)$      (c) $(-2, 3)$      (d) $(2, -3)$

**Q10.** $\lim\limits_{x \to 0} \frac{10^x - 5^x - 2^x + 1}{x^2}$ is

(a) $\log 5$      (b) $\log 2$      (c) $\log \frac{5}{2}$      (d) $\log 5 \log 2$

**Q11.** If $A$ lies in the second quadrant and $3 \tan A + 4 = 0$, then the value of
$2 \cot A - 5 \cos A + \sin A$ is

(a) $-\frac{53}{10}$      (b) $\frac{23}{10}$      (c) $\frac{37}{10}$      (d) $-\frac{37}{10}$

**Q12.** The coefficient of $x^2$ in the expansion of $(1 - 2x)^5$ is

(a) $-80$      (b) $-40$      (c) $40$      (d) $80$

**Q13.** The equation of the directrix of the parabola $y^2 = 16x$ is

(a) $x = 4$      (b) $x = -4$      (c) $y = 4$      (d) $y = -4$

**Q14.** The derivative of $\sin 2x$ at $x = \frac{\pi}{6}$ is

(a) $-1$      (b) $\frac{\sqrt{3}}{2}$      (c) $0$      (d) $1$

**Q15.** Find $n(S \cap P)$, where
$S = \{x : x \text{ is a multiple of } 3 \text{ less than } 20\}$ and
$P = \{x : x \text{ is a prime number less than } 20\}$.

(a) 0      (b) 1      (c) 2      (d) 3

**Q16.** Given that the general term of a sequence is $T_n = \begin{cases} n(n+2), & \text{if } n \text{ is even} \\ \frac{4n}{n^2+1}, & \text{if } n \text{ is odd} \end{cases}$ Find the $15^{\text{th}}$ term.

(a) 240      (b) 255      (c) $\frac{10}{113}$      (d) $\frac{30}{113}$

**Q17.** The image of the point $(4, -7, 6)$ in the $xy$-plane is

(a) $(4, -7, -6)$      (b) $(-4, 7, -6)$      (c) $(4, -7, 6)$      (d) $(-4, 7, 6)$

**Q18.** The distance of the point $(4, 6, -8)$ from the $x$-axis is

(a) 10 units      (b) $\sqrt{116}$ units      (c) 4 units      (d) $\sqrt{52}$ units

## ASSERTION–REASON BASED QUESTIONS

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R).
Choose the correct answer from the options given below:

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

**Q19.**
**Assertion (A): The number of permutations of the letters of the word *INDEPENDENCE* is**

$$\frac{12!}{3! \ 4! \ 2!}$$

**Reason (R): The number of permutations of $n$ different objects taken $r$ at a time, where $0 < r \le n$ and repetition is not allowed, is $^nP_r$.**

**Q20.**
**Assertion (A): $A = \{x \in \mathbb{R}: 3 < x < 4\}$ is an infinite set.**

**Reason (R): Between any two real numbers, there are infinitely many real numbers.**

## SECTION B (5 X 2 =10)

**Q21. If**
**$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8\}$, $C = \{3, 4, 5, 6\}$, find:**

**(i) $(A \cup B)'$**
**(ii) $(B - C)'$**

**Q22. Find the real values of $x$ and $y$ if $\frac{x+iy}{1+i}$ is the conjugate of $5 - i$.**

**Q23. Find the term independent of $x$ in the expansion of**
$$\left(x - \frac{1}{3x^2}\right)^{12}, x \ne 0.$$

**Q24. Find the variance of all the factors of 6.**

### OR

**The mean of 50 observations is 20 and their standard deviation is 2.**
**Find the sum of squares of all the observations.**

**Q25. Define the Greatest Integer Function. Draw its graph for**
**$-2 < x < 2$. Hence, find the values of $[-1.9]$ and $[1.2]$.**

### OR

**Let the relation $R$ be defined on $\mathbb{N}$ such that**

$$R = \{(x, y): y = 2x, \ x, y \in \mathbb{N}\}.$$

**Find the Domain, Codomain, and Range of $R$. Is this relation a function?**

## SECTION C (6 X 3 =18)

**Q26. Show that for any two sets $A$ and $B$,**

$$A \cup B = A \cap B \implies A = B.$$

**Q27. Solve the following system of inequalities in $\mathbb{R}$:**

$$\frac{7x-1}{2} < -3, \frac{3x+8}{5} + 11 < 0,$$

**and hence represent the solution on the real number line.**

or

**How many litres of water must be added to 600 litres of a 45% acid solution so that the resulting mixture contains more than 20% but less than 30% acid?**

**Q28. Find the equation of the hyperbola having foci $\left(0, \pm\sqrt{10}\right)$ and passing through the point $(2, 3)$.**

or

**Find the equation of the ellipse whose centre is at the origin, length of the major axis is $\frac{9}{2}$, and eccentricity $e = \frac{1}{\sqrt{3}}$, where the major axis is along the horizontal axis.**

**Q29. Find the domain of the function $f(x) = \frac{1}{\sqrt{x+|x|}}$.**

**Q30. Find the ratio of two positive numbers $a$ and $b$ such that AM:GM $= 2:1$.**

**Q31. Find $\sin\frac{x}{2}$, $\cos\frac{x}{2}$ and $\tan\frac{x}{2}$ when $\tan x = -\frac{4}{3}$, $x$ lies in Quadrant II.**

or

**Prove that: $\frac{\sec 8x - 1}{\sec 4x - 1} = \frac{\tan 8x}{\tan 2x}$.**

### SECTION D (4 X 5 =20)

**Q32. For the function $f$ defined by $f(x) = \sin x$, complete the following table:**

| x | $-2\pi$ | $\frac{-3\pi}{2}$ | $-\pi$ | $\frac{-\pi}{2}$ | 0 | $\frac{\pi}{2}$ | $\pi$ | $\frac{3\pi}{2}$ | $2\pi$ |
|---|---|---|---|---|---|---|---|---|---|
| f(x) | | | 0 | | 0 | 1 | | | |

**Hence, draw the graph using an appropriate scale. Also, find the maximum and minimum values of $y$.**

**Q33. Aman saw his younger brother playing with building blocks. He observed that the boy was forming a pattern by first making a tower of 32 blocks, then a tower of 16 blocks, and so on, till he made a tower of 1 block.**

**(a) What kind of pattern is the boy making? Also, how many towers did the boy make?**
**(b) How many blocks in total did the boy use?**

OR

On a Sunday, Sunil and his friend went to see a circus show and observed that the arrangement of chairs in rows followed a particular pattern. The number of chairs in the first row is 75 and in the third row is 125. The number of chairs increases by a fixed number in each row. There are 12 rows of chairs in all.

(a) How many chairs are there in the 7th row, where Sunil's friend is seated?
(b) If all the chairs are occupied, how many people watched the show? Also, find the arithmetic mean of the number of chairs in the rows where Sunil and his friend were seated.

Q34. Find the derivative of $x\sin x$ using first principles.

<div align="center">OR</div>

If $f(x) = ax^2 + bx + 12$, $f'(4) = 15$ and $f'(2) = 11$, find the values of $a$ and $b$.

Q35. The mean and variance of 7 observations are 8 and 16 respectively. If five of the observations are 2, 4, 10, 12 and 14, find the remaining two observations.

<div align="center">SECTION E (3 X 4 =12)</div>

Q36. A student has 4 library tickets. In the library, there are 2 language books, 4 subject-specific books, and 3 fictional books of his interest. From these 9 books, he selects exactly 2 subject-specific books and 2 other books.

Based on the above information, answer the following:

(i) In how many ways can he borrow the four books?

(ii) After selection, in how many ways can he arrange the borrowed books on his bookshelf so that the subject-specific books are always kept together?

Q37. Ram and Rahim are cousins living in the same colony. The lanes in which their houses are located are represented by the lines

$$4x - 3y + 6 = 0 \text{ and } 4x - 3y - 9 = 0,$$

respectively.



Based on the above information, answer the following:

(i) Find the slope of the lane in which Rahim lives.

**(ii) Find the angle between the two lanes.**

**(iii) Find the distance of the point $(0, 2)$ on Ram's lane from Rahim's lane.**

**Q38. Two students, A and B, appeared in an examination. The probability that A qualifies the examination is 0.05 and the probability that B qualifies the examination is 0.10. The probability that both A and B qualify the examination is 0.02. Based on the above information, answer the following:**

**(i) What is the probability that neither A nor B qualifies the examination?**

**(ii) What is the probability that at least one of them qualifies the examination?**

**(iii) What is the probability that exactly one of them qualifies the examination?**

**Or**

**What is the probability that at most one of them qualifies the examination?**

**\*\*\*\*\*\*\*\*\*\*\*\*BEST OF LUCK\*\*\*\*\*\*\*\*\*\*\*\*\***